



TCS Software
Preliminary Design Review

Top Level Design
Section 1

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**NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION**



Agenda

- PDR Part I Review
- Operational Model
- Top Level Design
 - Section 1: CSCIs Overview
 - Section 2: DCM CSCIs
 - Section 3: RTP CSCI
 - Section 4: DataServer CSCI
 - Section 5: DII CSCI
 - Section 6: Route & Payload Planner CSCI
 - Section 7: Common AV & Payload CSCI



CSCIs Top Level Design Overview

Interfaces

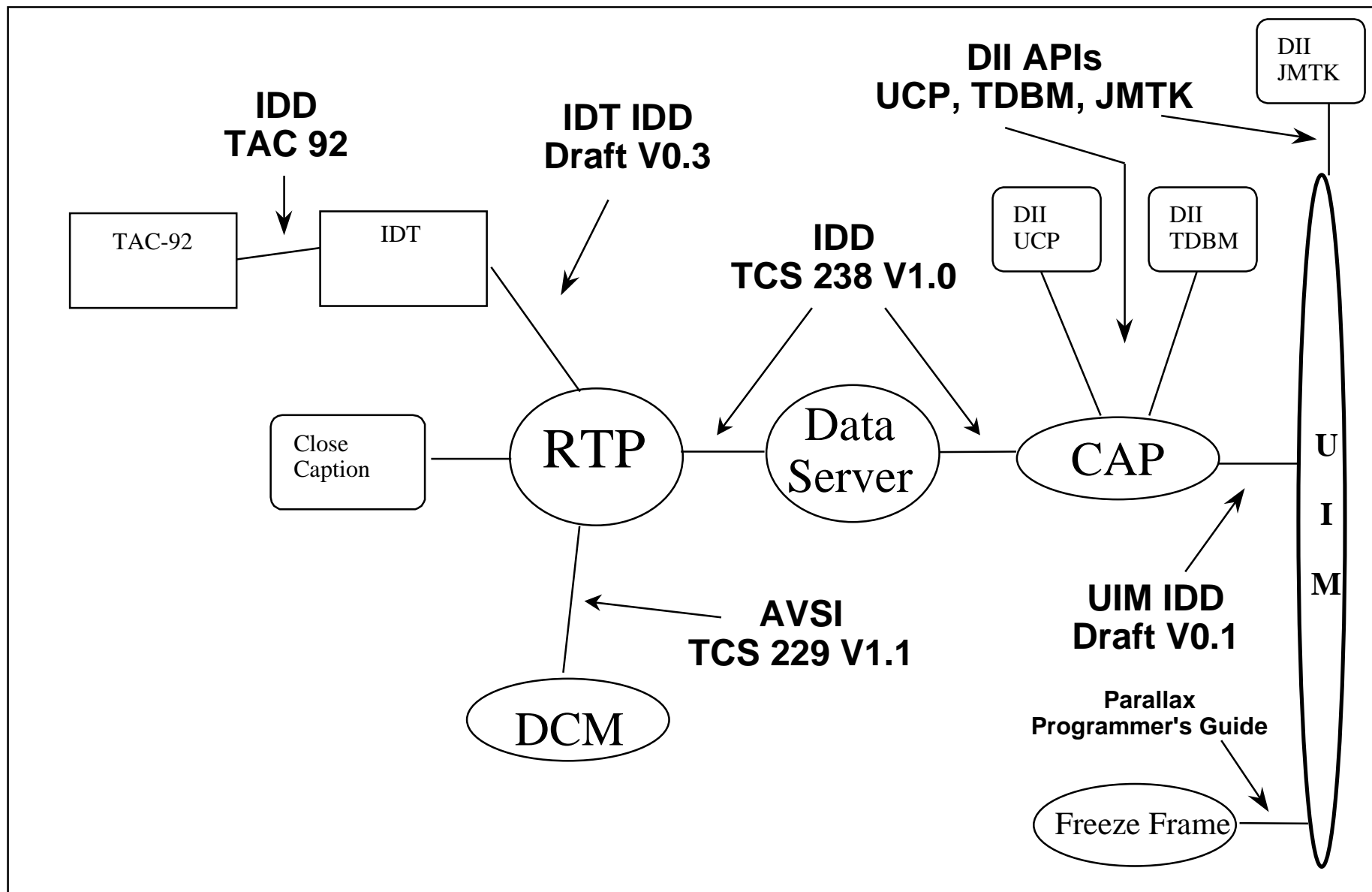
Disk Storage

Data Flow

Run States



Interfaces





Disk Storage Utilization

• OS & Files	464.6 MBytes
• DII Core	245.1 MBytes
• DII JMTK	62.0 MBytes
• DII Comms	108.5 MBytes
• TCS	572.0 MBytes
– CAP	20.3 MBytes
– RPP	551.7 Mbytes
– DS	1.6 MBytes
– RTP	1.9 Mbytes



Data Flow



AVSI Messages

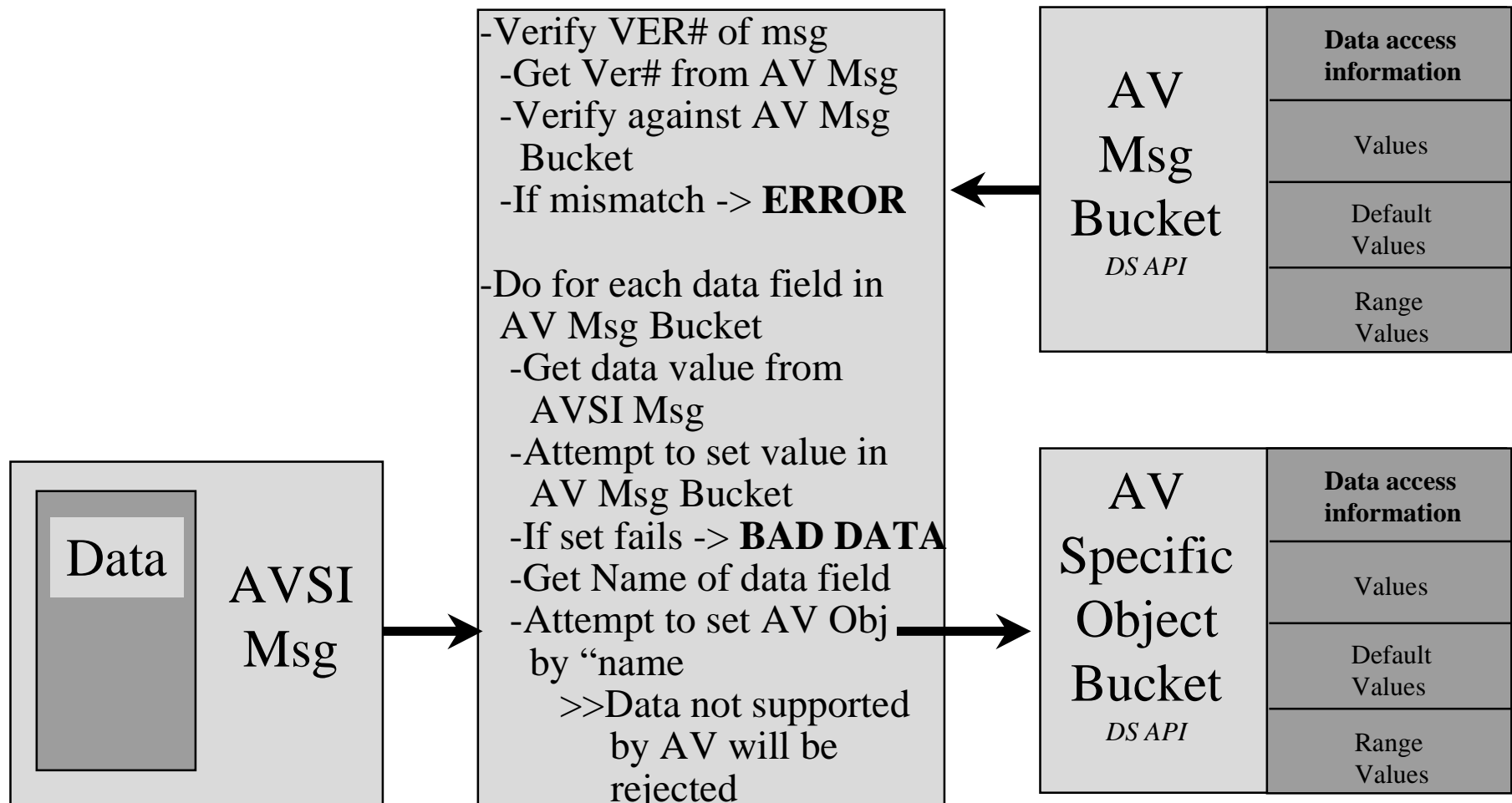
- For every AVSI Message
 - There is a corresponding but AV specific DataServer Bucket
- AVSI Messages are built as a composite/superset of data supported by the AVs
 - Unsupported fields are zeroed
- These composite messages are then converted to internal AV specific version of the message
 - Unsupported fields are not in the bucket



AVSI Mapping to TCS Buckets

•Initialization:

- Create AV Msg Bucket
- Create AV Specific Object Bucket
- Populate AV Specific Object with default values from AV Msg Bucket





Schema Example

AVSI Version of AV Position Status

```
AV_Position_Status
{
    # Version and configuration information
    Version "$Id$";
    Config COMMON_GROUP;
    # Constant telling which message this is
    Message_ID: const integer, 1, "Message ID";
    # Constant telling the IDD version for the message definition
    Message_Version: const integer, COMMON_VERSION, "Message Version";
    # Type of AV:
    AV_Type: integer, AV_COMMON, 1 .. AV_TYPE_LIMIT, "Type of AV";
    # Air Vehicle Tail number (13 characters long, last char is NULL)
    AV_Tail_Number: string[13], "UAV000  ", "Tail Number";
```

○
○
○

GPS Time fields: weeks, seconds, and nanoseconds. Note: GPS week
will roll over to 0 in August 1999.

AV_GPS_Time_Week: integer, 0, 0 .. 1023, "weeks", "GPS Time";

AV_GPS_Time_Second: integer, 0, 0 .. 604799, "sec", "GPS Time";

AV_GPS_Time_Ns: integer, 0, 0 .. 999999999, "ns", "GPS Time";

Altitude as sensed by the barometer

AV_Baro_Altitude: real, 0.0, AV_ALT_MIN .. AV_ALT_MAX, "ft",
"Barometric Altitude";

Altitude as sensed by the radar

AV_Radar_Altitude: real, 0.0, AV_ALT_MIN .. AV_ALT_MAX, "ft",
"Radar Altitude";

Heading as sensed by the magnetometer

AV_Magnetometer_Heading: real, 0, [0.0, 360.0), "deg", "Mag Heading"



Schema Example

Predator's Version of AV Position Status

```
AV_Position_Status
{
    # Version and configuration information
    Version "$Id$";
    Config PREDATOR_GROUP;
    # Constant telling which message this is
    Message_ID: const integer, 1, "Message ID";
    # Constant telling the IDD version for the message definition
    Message_Version: const integer, PREDATOR_VERSION, "Message Version";
    # Type of AV:
    AV_Type: const integer, AV_PREDATOR, "Type of AV: Predator";
    # Air Vehicle Tail number (13 characters long, last char is NULL)
    AV_Tail_Number: string[13], "UAV000  ", "Tail Number";
```



```
# GPS Time fields: weeks, seconds, and nanoseconds. Note: GPS week
# will roll over to 0 in August 1999.
```

```
AV_GPS_Time_Week: integer, 0, 0 .. 1023, "weeks", "GPS Time";
```

```
AV_GPS_Time_Second: integer, 0, 0 .. 604799, "sec", "GPS Time";
```

```
→ # AV_GPS_Time_Ns: integer, 0, 0 .. 999999999, "ns", "GPS Time";
```

```
# Altitude as sensed by the barometer
```

```
AV_Baro_Altitude: real, 0.0, -3000 .. 60000, "ft",
    "Barometric Altitude";
```

```
# Altitude as sensed by the radar
```

```
→ # AV_Radar_Altitude: real, 0.0, AV_ALT_MIN .. AV_ALT_MAX, "ft",
#     "Radar Altitude";
```

```
# Heading as sensed by the magnetometer
```

```
AV_Magnetometer_Heading: real, 0, [0.0, 360.0), "deg", "Mag
Heading";
```

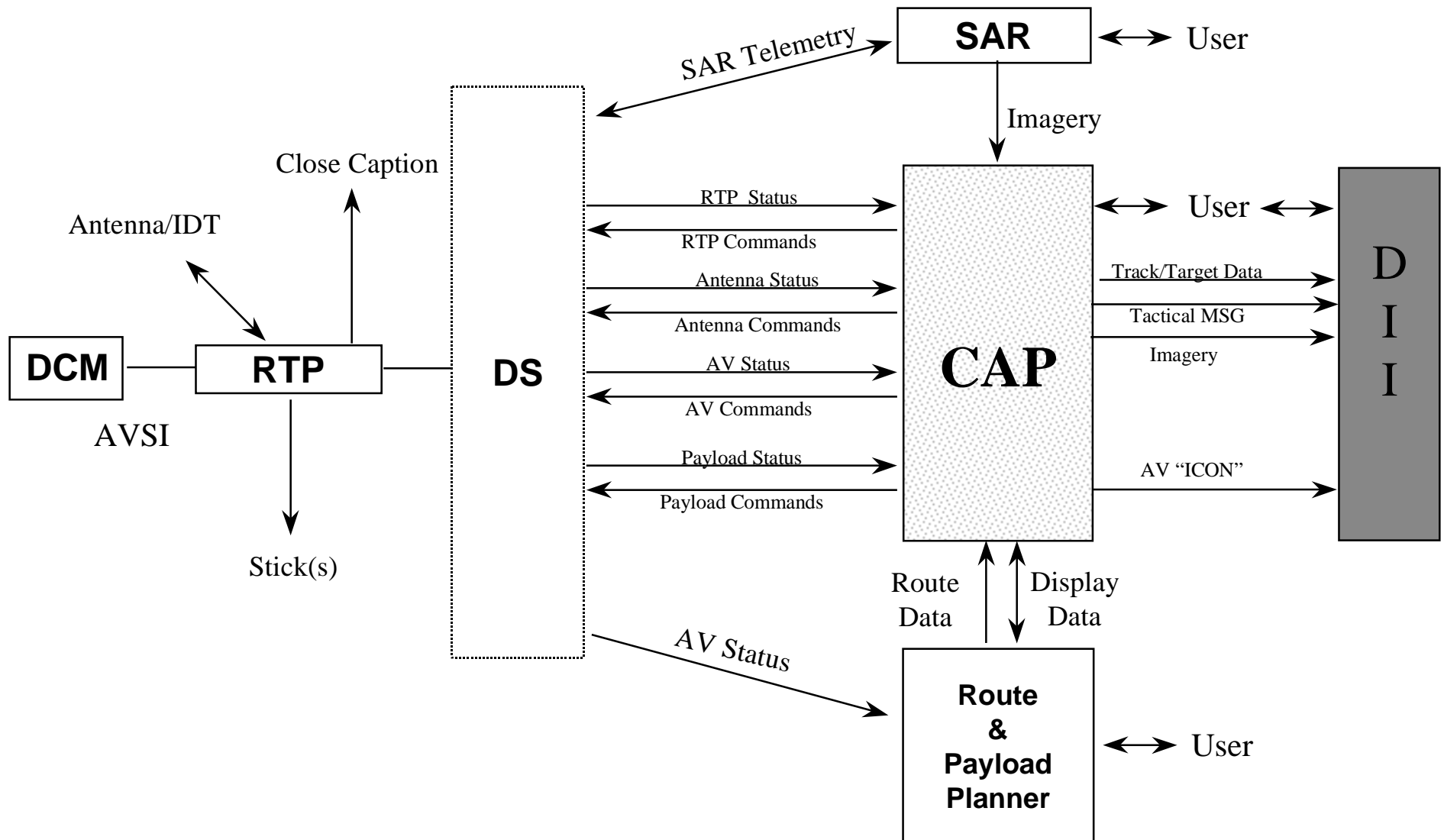


TCS Buckets

Downlink (DCM to TCS)	Uplink (TCS to DCM)
AV Position Status	AV Flight Mode Command
AV INS Status	AV Flight Envelope Command
AV GPS Status	AV Lights Command
AV EOIR Status	TCS Position Uplink
AV Line of Sight GDT Status	TCS Environmental Data Uplink
AV Line of Sight ADT Status	EOIR Command
AV Piston Engine Status	AV Analog Video Command
AV Fuel Status	AV Waypoint Begin
AV Electrical System Status	AV Piston Engine Command
AV Analog Video System Status	AV IFF Command
AV Lights and Landing Gear Status	AV Fuel System Command
AV IFF Status	Ground Line of Sight Datalink Command
AV SAR Status	Airborne Line of Sight Datalink Command
AV Warning	Airborne SATCOM Datalink Command
DCM Protocol Error	
DCM Mission Load Acknowledge	
AV Servo Status	



TCS CSCIs Data Flow





CSCIs Run States

Startup
Operations
Shutdown



System States

- (SSS014)[SSDD0263]

The TCS Core Functionality CSCIs shall provide and control the TCS states of operation, Startup, Operation, and Shutdown.

- Startup

- The process of applying power to equipment and the activation of those HWCIIs and CSCIs necessary for Operations.

- Operations

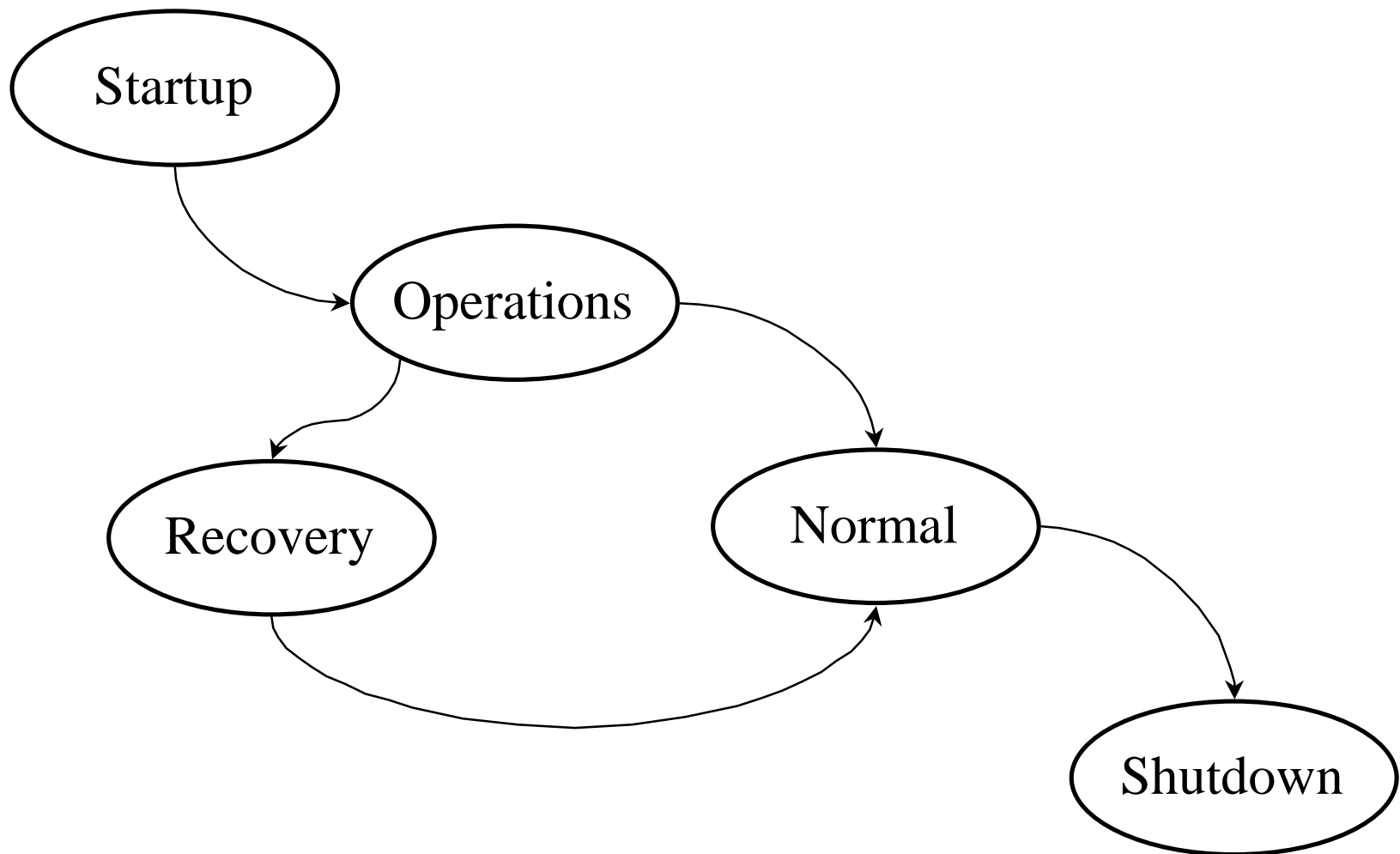
- All HWCIIs & CSCIs are in a state ready to accept and process commands

- Shutdown

- Command from the operator to halt equipment in preparation for power down

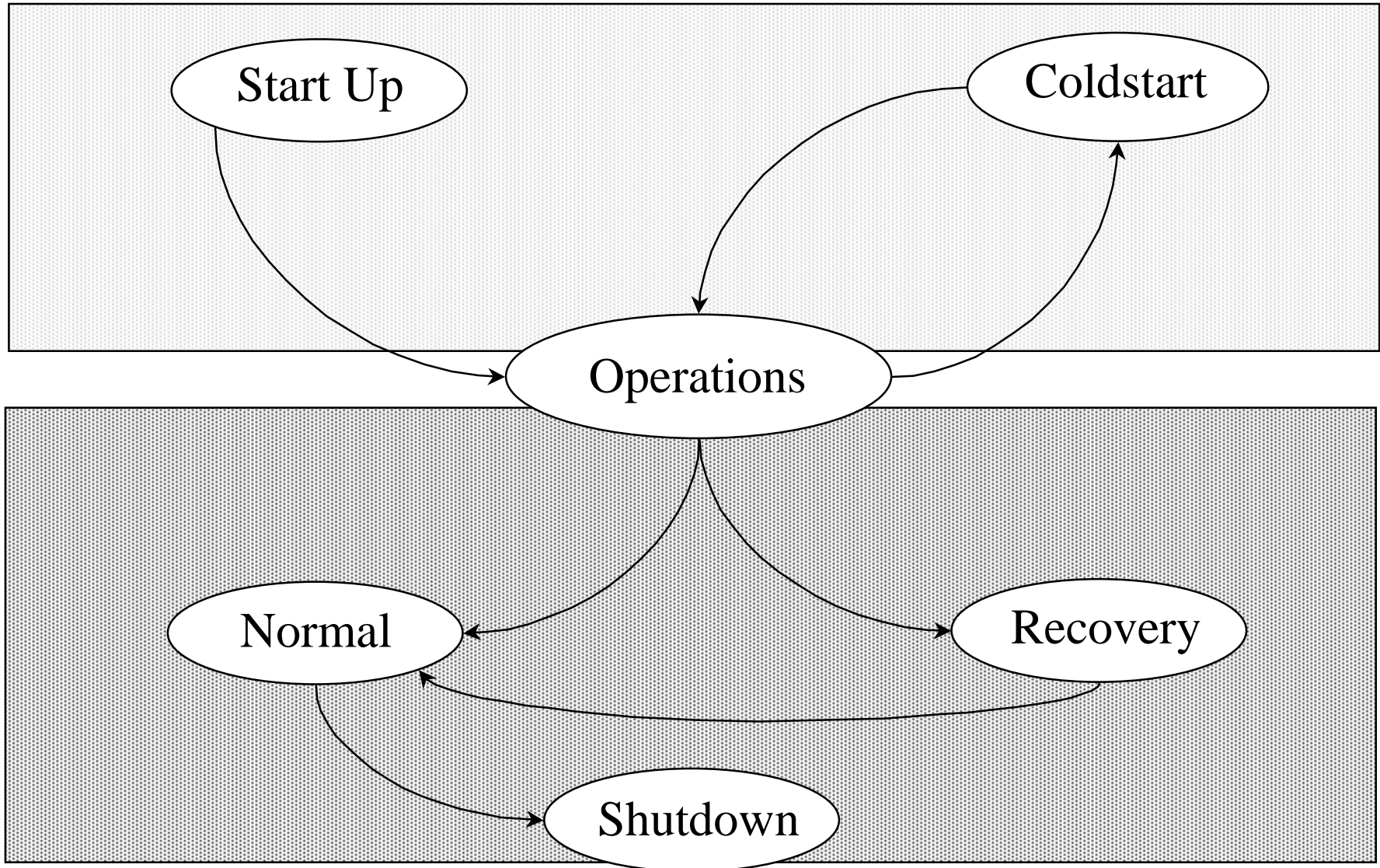


System States





Software States





Startup State



Startup

- The process of applying power to equipment and the activation of those HWCIIs and CSCIs necessary for Operations.
 - Startup is divided into the following substates
 - Coldstart
 - Start up with no configuration data and no state data
 - Manual configuration is required
 - Startup or Normal Startup
 - Start up with configuration data and state data



Startup - *Coldstart*

- Manual Coldstart operations
 - Hardware, Network, OS, DII, & TCS configuration
 - Installation and/or removal of equipment
 - Network setup
 - Routers/Hubs, etc.
 - DII/OS Configuration
 - Network Addresses
 - Host Tables
 - DII Software/Segment Installer
 - DII User Accounts



Startup - *Coldstart*

- Coldstart (*Continued*)
 - TCS Setup
 - Create/modify a “database” that identifies TCS’s hardware assets
 - TCS “power up”
 - Ensure that all equipment as specified in Setup is powered up and operational



Startup: DCM(s)

- Auto boot, load, and start DCM CSCI
 - COLDSTART:
 - Same as Normal Mode
 - NORMAL STARTUP:
 - DCM starts and initializes its CSCs.
 - Waits of a connection from RTP.
 - Once connected begin processing commands and make available any downlink data if present.
 - RECOVERY:
 - Same as Normal



Startup: RTP

- RT
 - Auto boot, load, and start RTP_Exec CSC
 - COLDSTART:
 - Wait for RTP configuration data
 - Enter Normal mode when “config” bucket received
 - NORMAL STARTUP:
 - Get RTP configuration data.
 - Start required CSCs.
 - Wait for commands
 - RECOVERY:
 - Same as Normal State



Startup: RTP *(Continued)*

- DS
 - Auto boot, load, and start DataServer CSCI
 - COLDSTART:
 - Same as Normal State
 - NORMAL STARTUP:
 - Start and initialize all CSCs.
 - Read Persistent Storage File if one exists.
 - » Persistent storage is used to save the last valid data set. This data is automatically returned when bucket is re-created by an application
 - » Wait for connections and process commands as they arrive
 - RECOVERY:
 - Same as Normal



Startup: SAR

- Auto boot, load, and start SAR CSCI
 - COLDSTART:
 - Same as Normal state
 - NORMAL:
 - Start and initialize all CSCs.
 - Go to an idle state awaiting commands
 - RECOVERY:
 - Same as Normal state



Startup: DII/Workstation(s)

- Auto boot, load, and start DII CSCI
 - COLDSTART:
 - Operator must configure workstation using supplied DII tools, Security Manager & SysAdmin
 - Operator logs in as TCS System Maintenance user
 - **Runs TCS Setup to configure TCS**
 - NORMAL STARTUP:
 - Operator logs in as a TCS operator
 - Operator initiates TCS functions as required



CSCIs Startup Sequence

				CSCIs			
<i>Seq</i>	DCM s	RTP	DataServer	CAP	DII	RPP	SAR
StartUp	Auto	Auto	Auto		Auto/Manual		Manual
Auto Boot	OS loads	OS loads	OS loads		OS loads		OS loads
Auto Load	OS starts DCM Sw	OS starts RTP_Exec	OS starts DataServer		OS start DII		Manual Start
INIT	Init	Init	Init		Init		Init
	Wait for RTP connect	Start CSC as per configuration	CSCs Init		DII starts segments		
		CSCs Init	Accept connections & Process Cmds				
	Connected	CSCs connect to device	Process Cmds				
	Report Status	Report status	"				
Idle	Idle	Idle	"				Idle



Operations State



Operations State

- All HWCIs & CSCIs are in a state ready to accept and process commands
 - Operational state consist of two substates
 - Normal Operations
 - State data indicates a startup after a normal system shutdown
 - Recovery
 - State data indicates that an operation was in progress and was not orderly terminated



Normal Operations State

- (SSS032)[SSDD285]

When in the Operations State the TCS Core Functionality CSCI shall provide a minimum of three modes: normal operations mode, training operations mode, and maintenance operations mode.

- Access to Normal Operations Mode shall be controlled by
 - DII Login/User Accounts
- Access to Training Operations Mode shall be controlled by
 - Designation of training missions

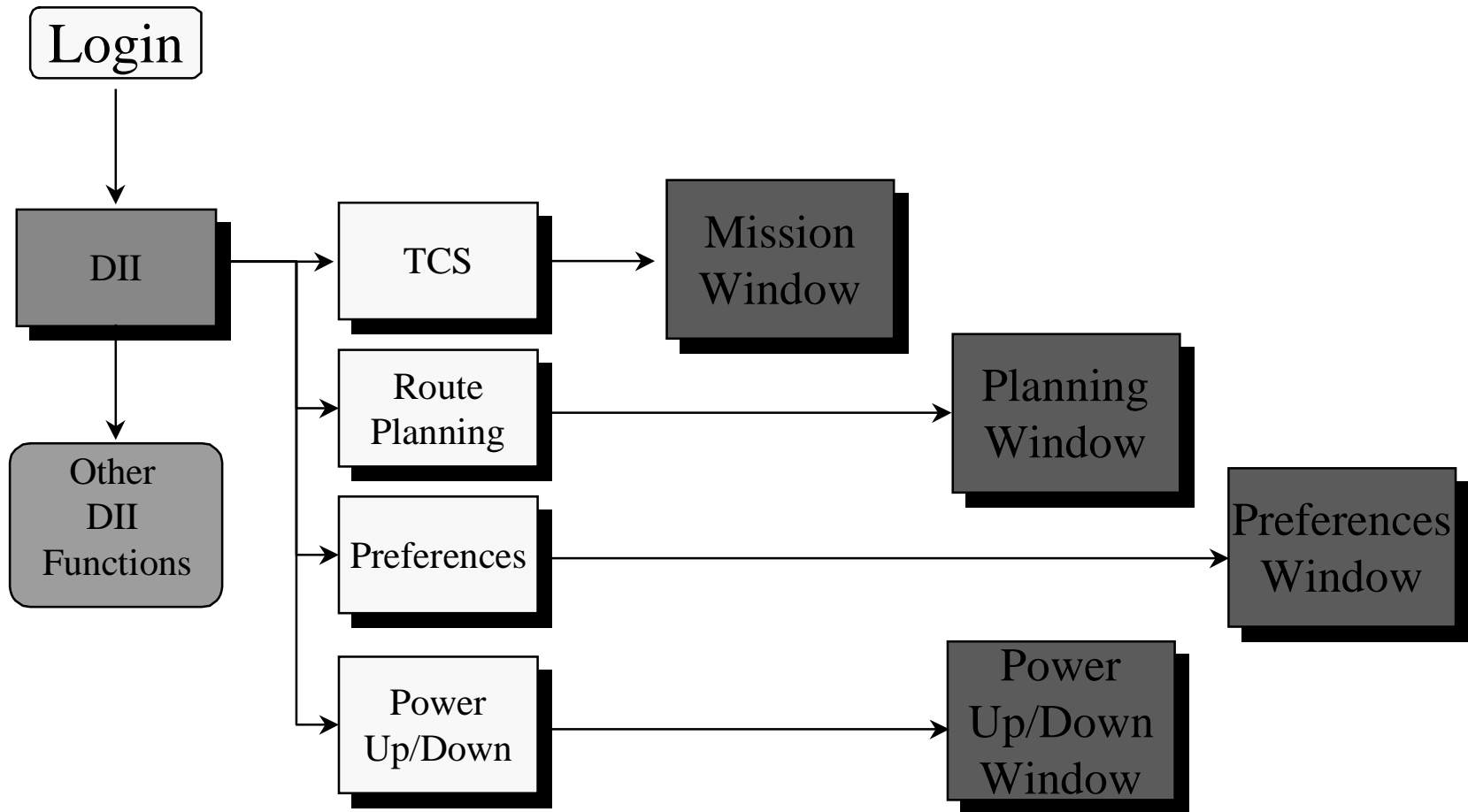


Normal Operations - Login Control

- Users will be classified as 1 of 3 types
 - TCS Operators: AVCs, AVOs, MPOs
 - User who is involved with the flight & control of a UAV and its payload(s)
 - TCS User: BFC, Client(s)
 - User who only monitors and/or processes data from a UAV
 - TCS Admin: System Maintenance
 - User who is involved with the configuration and setup of the system
- Their login account will be used to control access to TCS run time functionality

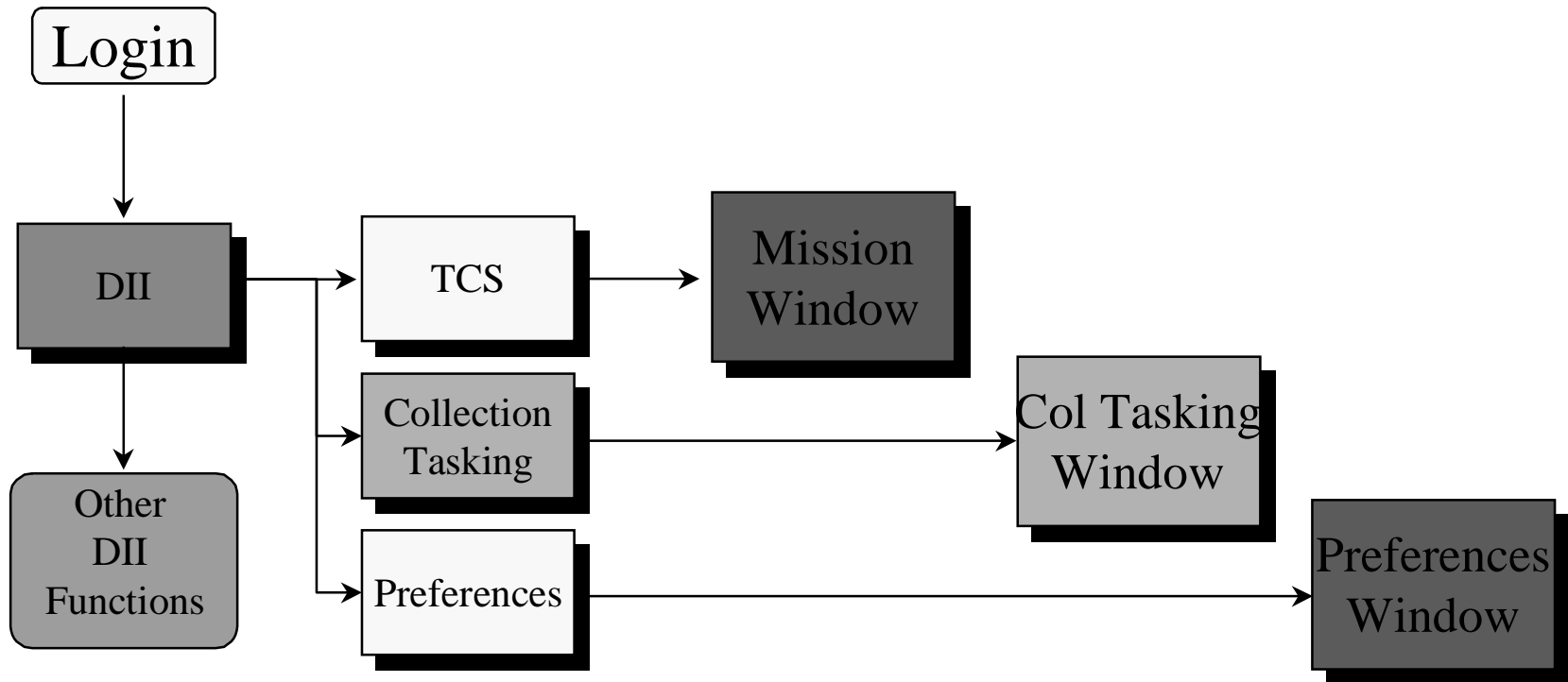


TCS Operator - Run Time Selections



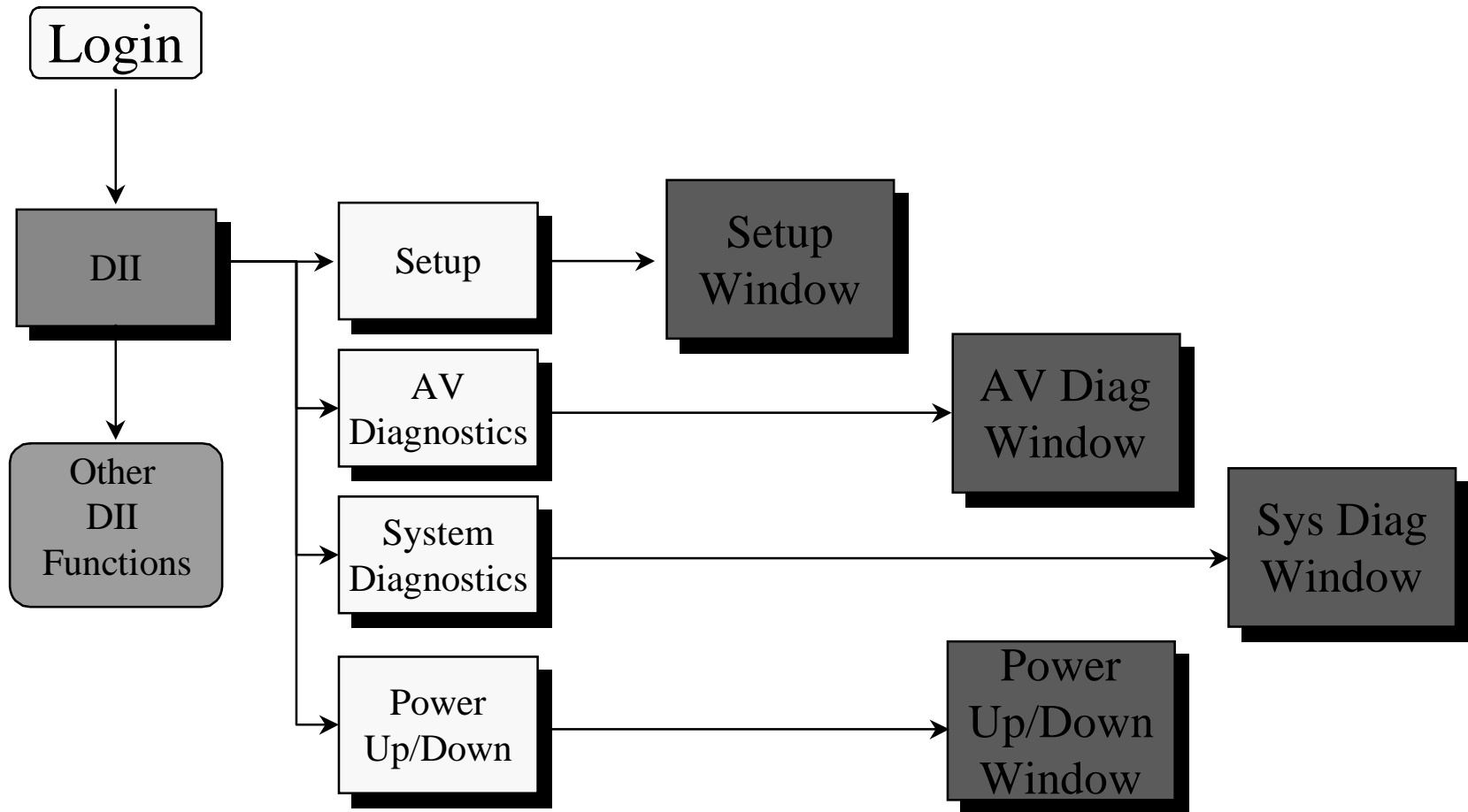


TCS User - Run Time Selections





TCS Admin - Run Time Selections





Recovery

- (SSS020)] [SSDD268]

When the TCS is halted due to an unplanned power interruption or abnormal program termination, TCS shall enter the Recovery Startup Mode upon the next startup cycle.

- Recovery is the responsibility of CAP CSCI
- All other CSCIs are “passive” with respect to the recovery process



Recovery: DII/Workstation(s)

- Operator restarts TCS
 - RECOVERY:
 - Workstation reboots
 - Operator logs in as TCS Operator or User
 - Re-selects previous running function/CSCI
 - Selected CSCI detects recovery state and begins recovery processing
 - Operator resumes operations



CSCIs Operations Sequence

				CSCIs			
<i>Seq</i>	DCMs	RTP	DataServer	CAP	DII	RPP	SAR
Operations	Idle	Idle	Process Cmds		Opr logins		Opr logins
	"	"	"		Opr selects Task to Run		Opr starts SAR
	"	"	"		DII starts selected function		Display Main Selection Window
START	"	"	"	DII starts TCS_Main		DII starts RPP	
	Process Cmds	Process Cmds	"	Init: Check role(s) and configuration		Init	
	"	"	"	Start required CSCs		Start required CSCs	
	"	"	"	Display Mission Window		Display Planning Window	
RUN	Process Cmds	Process Cmds	Process Cmds	Process Cmds	Process Cmds	Process Cmds	Process Cmds



Mission Operations



Operations - *Mission*

- A distributive environment requires the communication of an “execution plan” to all participants
 - Who is responsible for what
 - When things are to happen
 - What needs to be done
 - What equipment is required
- These are the type of things covered in a “mission”
 - » *Mission File will be the communication vehicle*



Mission File

- Mission File
 - Mission Purpose & Objectives
 - Mission overview or summary
 - Type of Mission; Operation, Exercise, or *Training*
 - Mission Execution Plan
 - Specifies required hardware resources
 - Operator/Workstation is performing which Role
 - Timeline, etc.
 - Collection Plan
 - AV & Payload Specs
 - Detailed data about AV & Payload
 - Datalink Plan
 - AV Route Data (Optional)
 - Payload Data (Optional)

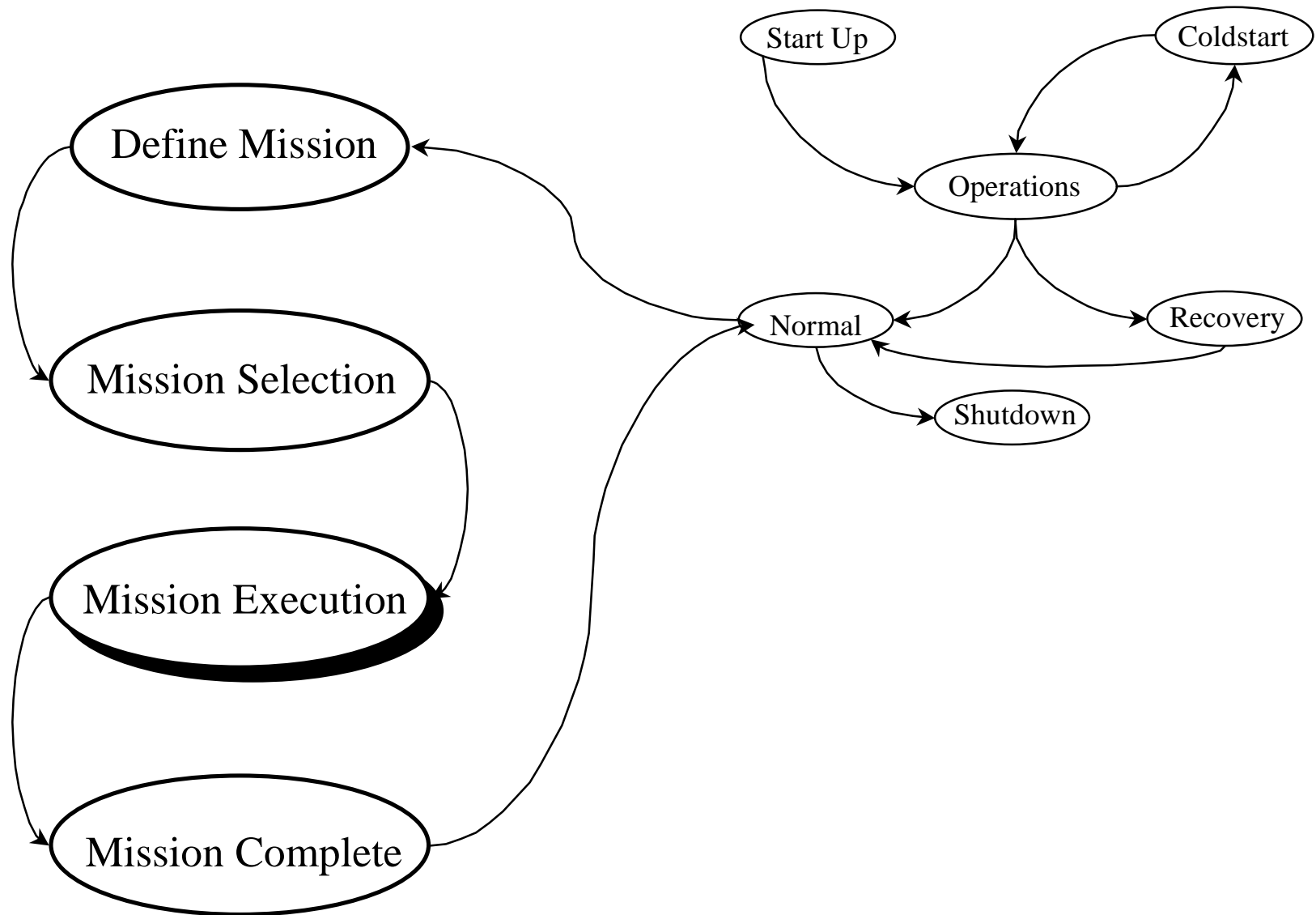


Mission Operations State

- A mission is executed as a series of steps
 - 1) Define mission
 - 2) Select mission for execution
 - 3) Execute operations as required to complete mission
 - 4) Mission completed



Mission Operations States





Mission Operations

State 1

- Mission Definition; AVC Role
 - Purpose of mission
 - Operation, Exercise, or **TRAINING**
 - Type of mission
 - Type of AV and type of payload
 - Builds route plan (Optional)
 - Identifies hardware asset required
 - Identifies operators for mission execution, AVO & MPO



Mission Operations

State 2

- Mission Selection
 - IF TCS User; Client
 - Monitor mission
 - IF TCS Operator; AVO
 - AV Control and all required CSCs are started
 - AVO Worklist is displayed to begin AV Ops
 - IF TCS Operator; MPO
 - Payload Control and all required CSCs are started
 - MPO Worklist is displayed to begin Payload Ops



Mission Operations

State 3

- Mission Execution
 - IF TCS User; Client
 - Monitor mission
 - May run EO/IR Imagery Viewer & Capture
 - May run Imagery Processing & Data Extraction Tool
 - IF TCS Operator; AVO
 - Perform operations as required via AVO Worklist
 - IF TCS Operator; MPO
 - Perform operations as required via MPO Worklist



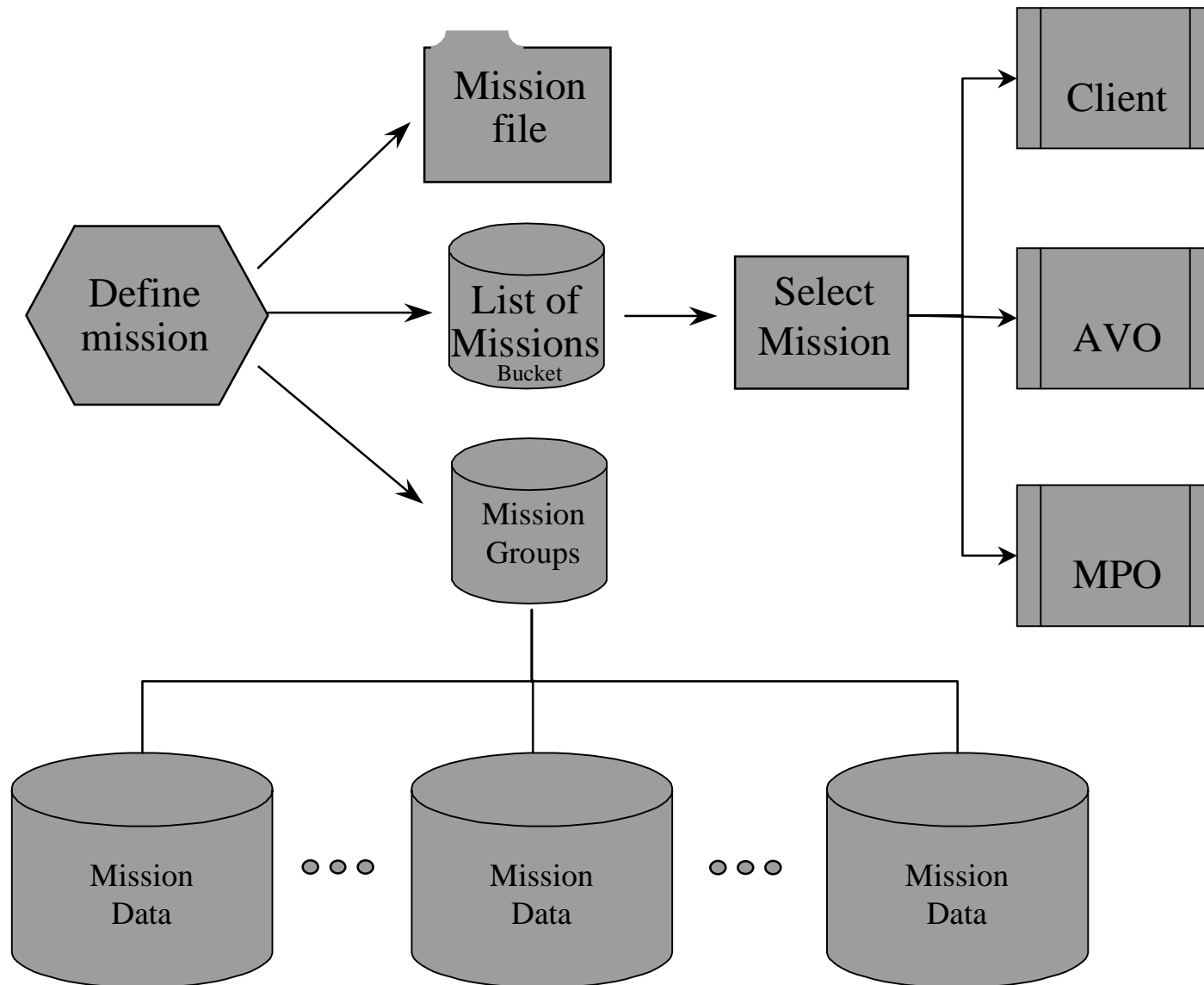
Mission Operations

State 4

- Mission Complete
 - IF TCS User; Client
 - Exits TCS function when done
 - Can occur any time during mission
 - IF TCS Operator; AVO
 - Mission complete after Handoff-Give or Recovery of AV
 - IF TCS Operator; MPO
 - Mission complete when all data collected
 - Workstation remains online as backup for AVO



Mission Flow





Mission List Bucket

- Mission List Bucket
 - Contains the List of Missions
 - Planned: Missions awaiting execution
 - Active: Missions being executed
- [Mission] Group
 - For each defined mission, a DataServer Group is created to hold the mission, AV specific data



Mission Data Buckets

- Mission Data Buckets
 - Mission Execution Plan
 - Specifies Required resources
 - Operator Workstations, AVO, MPO
 - Timeline, etc.
 - AV Data
 - Configuration, Autopilot Ver#, Capabilities (Day, D/Night, All Weather), Max Range, Max Flight Time, Payloads, etc.
 - Simplified Route Plan
 - AV & Payload Buckets
 - Datalink Data
 - RF Channels, Satcom, etc



SHUTDOWN



Shutdown

- (SSS035)[SSDD286]

The TCS Core Functionality CSCI shall provide the operator, via the Work Station Console, with the capability to command the system to the shutdown state from all modes under the Operations State.

- Shutdown will be limited to TCS Operators and TCS Admins

- AVC, AVO, MPO, & System Maintenance Roles
 - Shutdown will be designed to allow for the shutdown of all equipment or only selected equipment
 - Shutdown Order:
 - DCMs, RTP, DataServer, DII/Workstation
 - SAR may be shutdown when appropriate



Shutdown: DCM(s)

- Operator initiates shutdown
 - CSCIs receives shutdown notice
 - Orderly termination of all running CSCs to ensure no loss or corruption of data
 - Responds with shutdown “ACK” before final termination
 - Operator may power down unit



Shutdown: RTP

- RT
 - Operator initiates shutdown; AVC, AVO, TCS Admin
 - CSCI receives shutdown notice
 - Orderly termination of all running CSCs to ensure no loss or corruption of data
 - Responds with shutdown “ACK” before final termination
 - Initiates OS Shutdown
 - Operator may power down unit



Shutdown: RTP

- DS
 - Operator initiates shutdown; AVC, AVO, TCS Admin
 - CSCI receives shutdown notice
 - Orderly termination of all running CSCs to ensure no loss or corruption of data
 - Responds with shutdown “ACK” before final termination
 - Initiates OS Shutdown
 - Operator may power down unit



Shutdown: DII/Workstation(s)

- Operator exits TCS functions
- Operator activates Shutdown via DII
 - Shutdown begins termination process
 - Operator may shutdown down all or selected unit
 - Log out
- TCS/DII Admin logs in
 - Operator initiates shutdown via DII functions
- Operator may power down workstation



Shutdown: SAR

- Operator exits TCS functions and logs out
 - Log in as Admin
 - Operator initiates shutdown via SGI functions
 - Operator may power down unit



CSCIs Shutdown Sequence

				CSCIs			
<i>Seq</i>	DCM s	RTP	DataServer	CAP	DII	RPP	SAR
Shutdown	Idle	Idle	Idle	Opr exits function	Opr selects Shutdown to Run	Opr exits function	Opr exits function
					DII starts selected function		Manual shutdown via SGI cmds
				DII start TCS Setup(shutdown			Power down
Shutdown Command	Process Shutdown			Shutdown Command			
	Terminate all CSCs	Process Shutdown		Monitor shutdown			
	Shutdown ACK	Terminate all CSCs	Process Shutdown	"			
	Idle	Shutdown ACK	Terminate all CSCs	"			
		Terminate OS	Shutdown ACK	"			
			Terminate OS				
	Idle	Idle	Idle	Exit function	Log out		
					Log in as Admin		
					Shutdown DII		
					Terminate all DII Segments		
					Terminate OS		
	Idle	Idle	Idle	Idle	Idle	Idle	Idle
Power OFF	Power down	Power down	Power down	Power down	Power down	Power down	Power down



Confirm SHUTDOWN now?